Studying Jets with Identified Particles in AuAu Collisions

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Hard Probes

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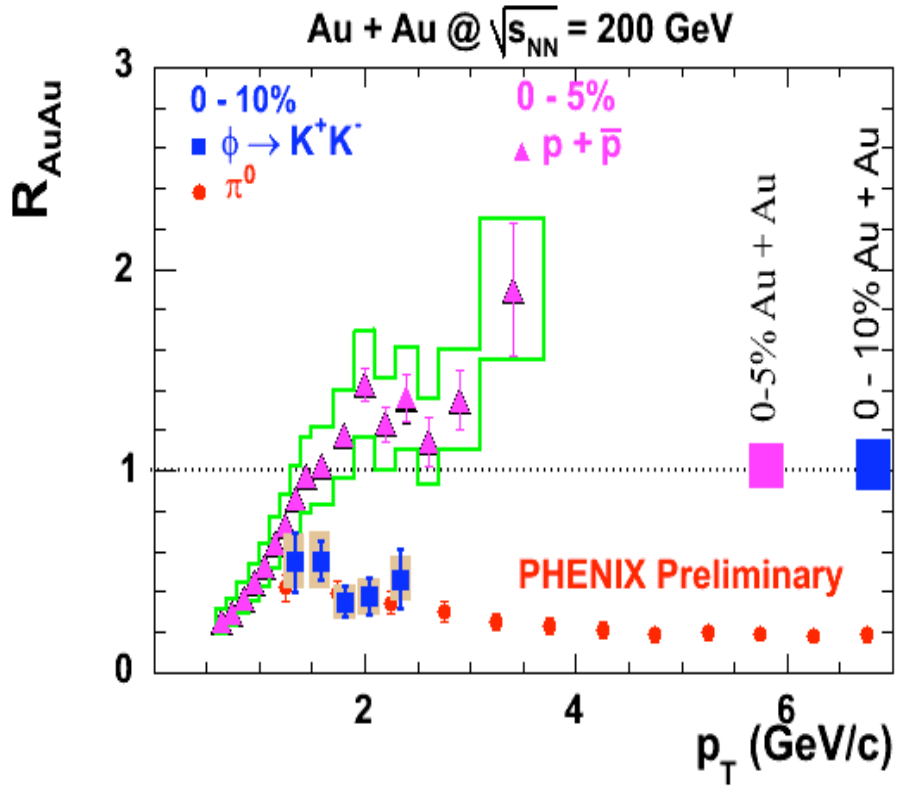
What Can We Learn?

- how is jet fragmentation modified?
- can we understand the role recombination plays in hadronization in AuAu collisions?
  - intermediate p_T (2-5GeV/c) shows baryon/meson difference which suggests recombination is important method of particle production

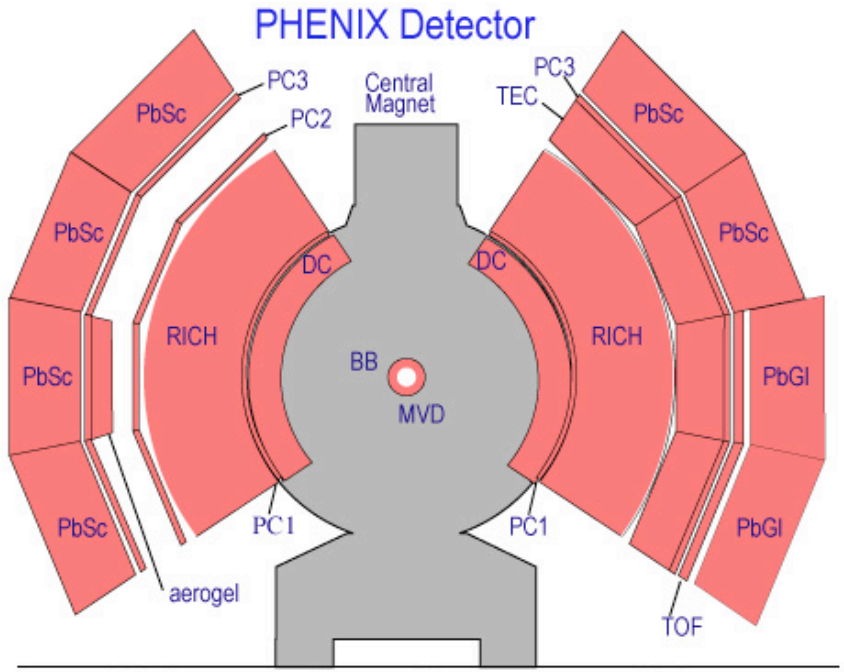


$$R_{AA} = \frac{(\text{Yield} / \text{Ncoll})_{Au-Au}}{\text{Yield}_{p-p}}$$

PHENIX

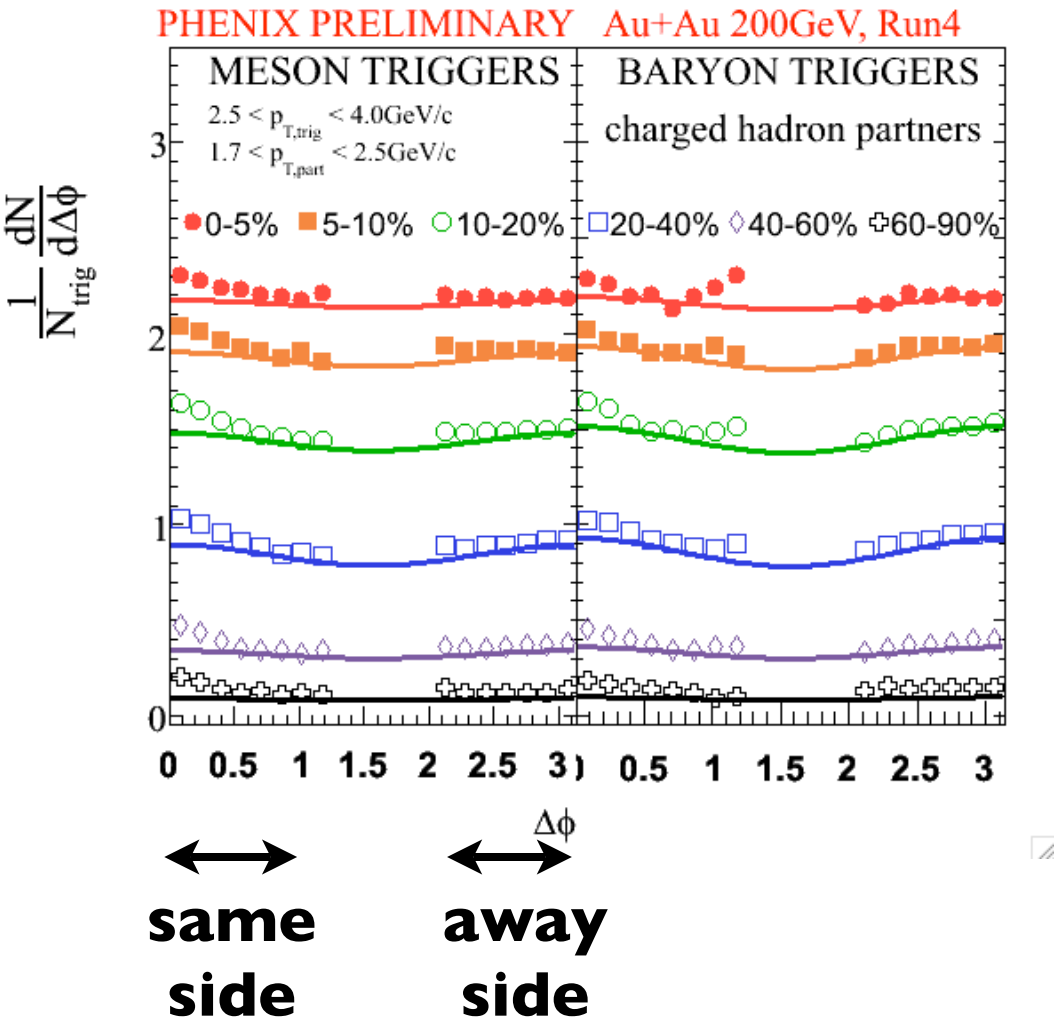
PHENIX is well suited to PID jet studies

- charged particle tracking over π in azimuth
- TOF provides baryon (p)/ meson (π,K) separation to ~4GeV/c over π/4 in azimuth
- EMCal provides baryon/ meson separation to ~2.5GeV/c over 3π/4 in azimuth



2-Particle Correlations

- make $\Delta\Phi$ distributions between trigger and associated particle
- use reaction plane v_2 values
- measure combinatoric background
- integrate the excess above flow modulated combinatoric background
  - $\Delta\Phi < 0.94$rad is same side conditional yield
  - $\Delta\Phi > \pi - 0.94$rad is away side conditional yield

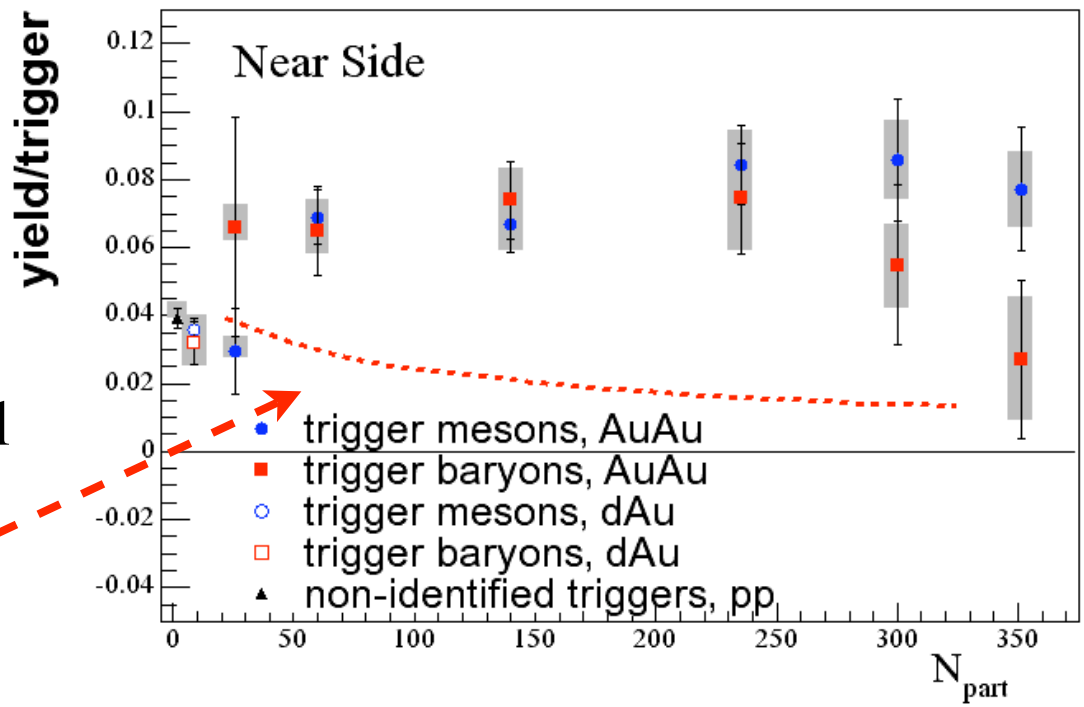


Same Side Correlations

Trigger Particle Dependence

trigger: 2.5<pT<4.0 GeV/c
partner: 1.7<pT<2.5 GeV/c
charged hadron partners

- measure correlations in the region of baryon/meson difference
  - triggers: baryon (p, anti-p) or meson (π, K)
- large difference between baryon & meson triggers in most central collisions (>10%)
  - not the same centrality dependence as p/π ratio



Baryon excess has hard scattering origin

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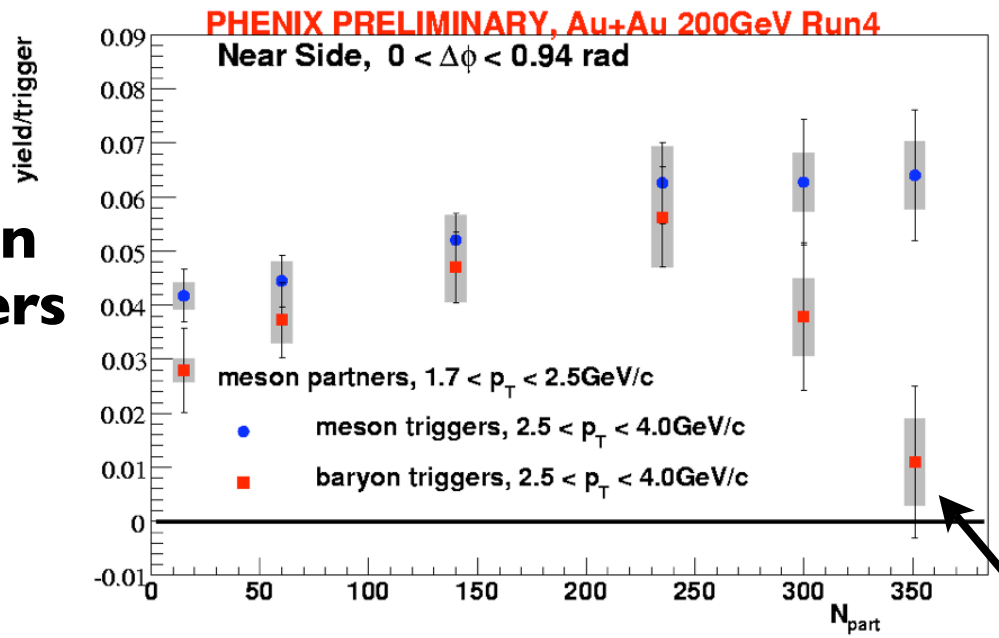
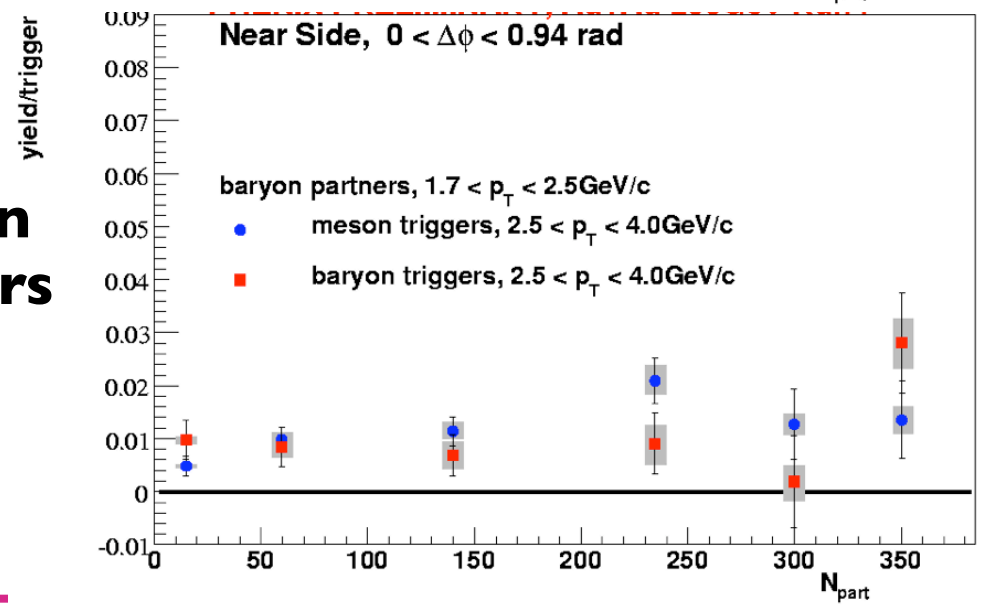
Both Particles Identified

meson partners



baryon partners



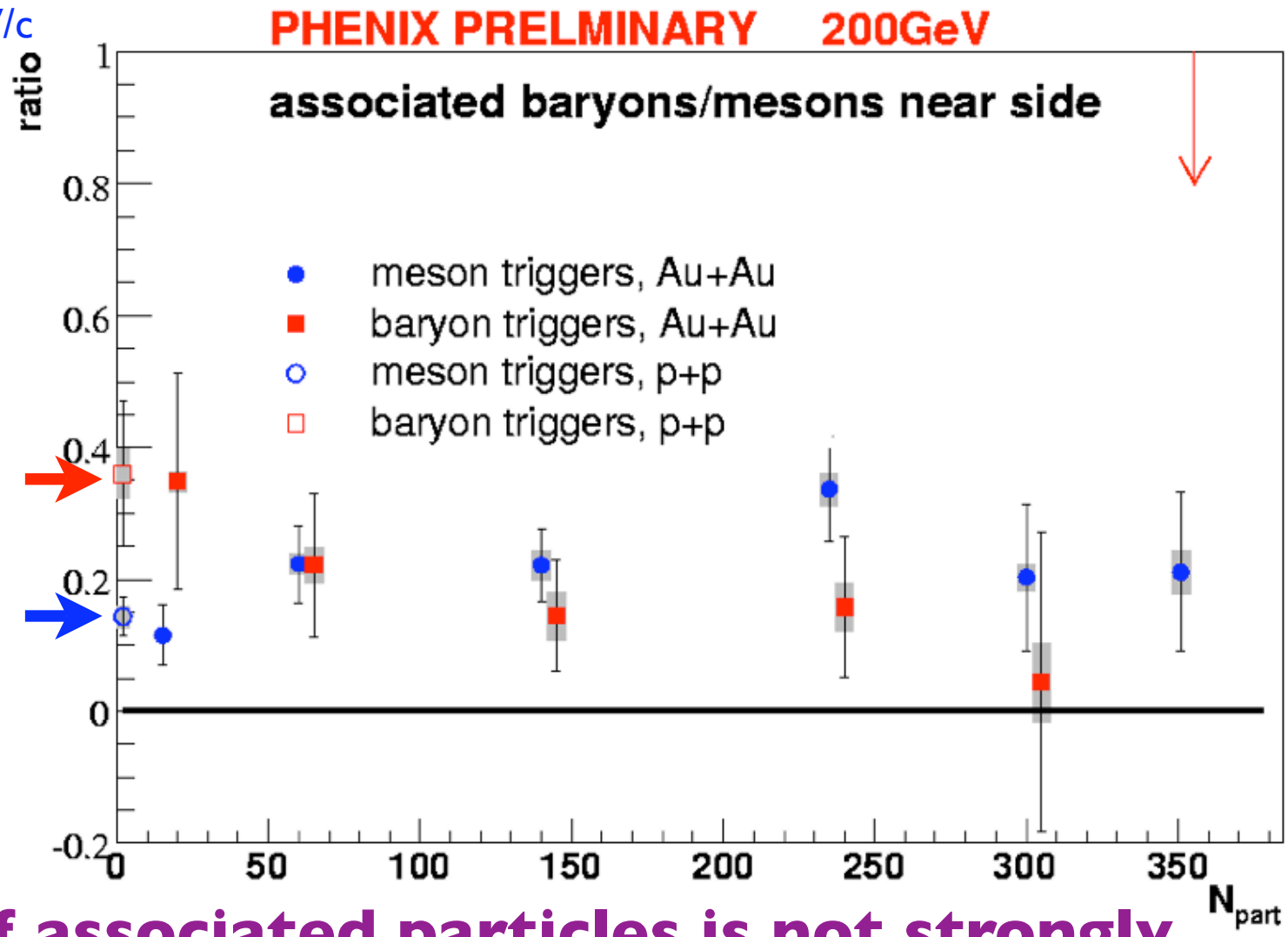
trigger: 2.5<pT<4.0 GeV/c
partner: 1.7<pT<2.5 GeV/c

- significant difference between baryon and meson triggers with meson partners, *only in very central collisions*
  - *what happens here?*
- no significant differences with baryon partners

Partner Ratios--Same Side

trigger: $2.5<p_T<4.0$ GeV/c
partner: $1.7<p_T<2.5$ GeV/c

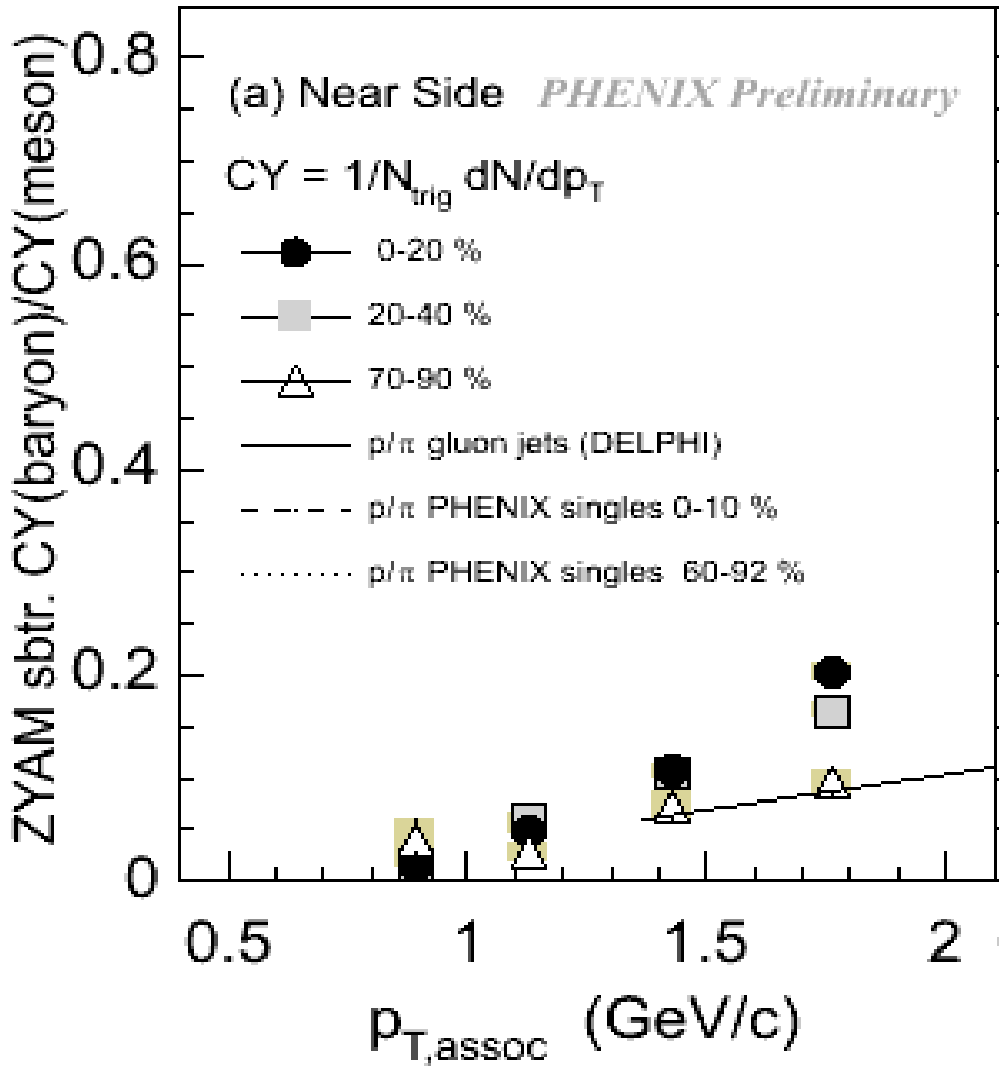
ratio from pp



Species of associated particles is not strongly modified--large error bars

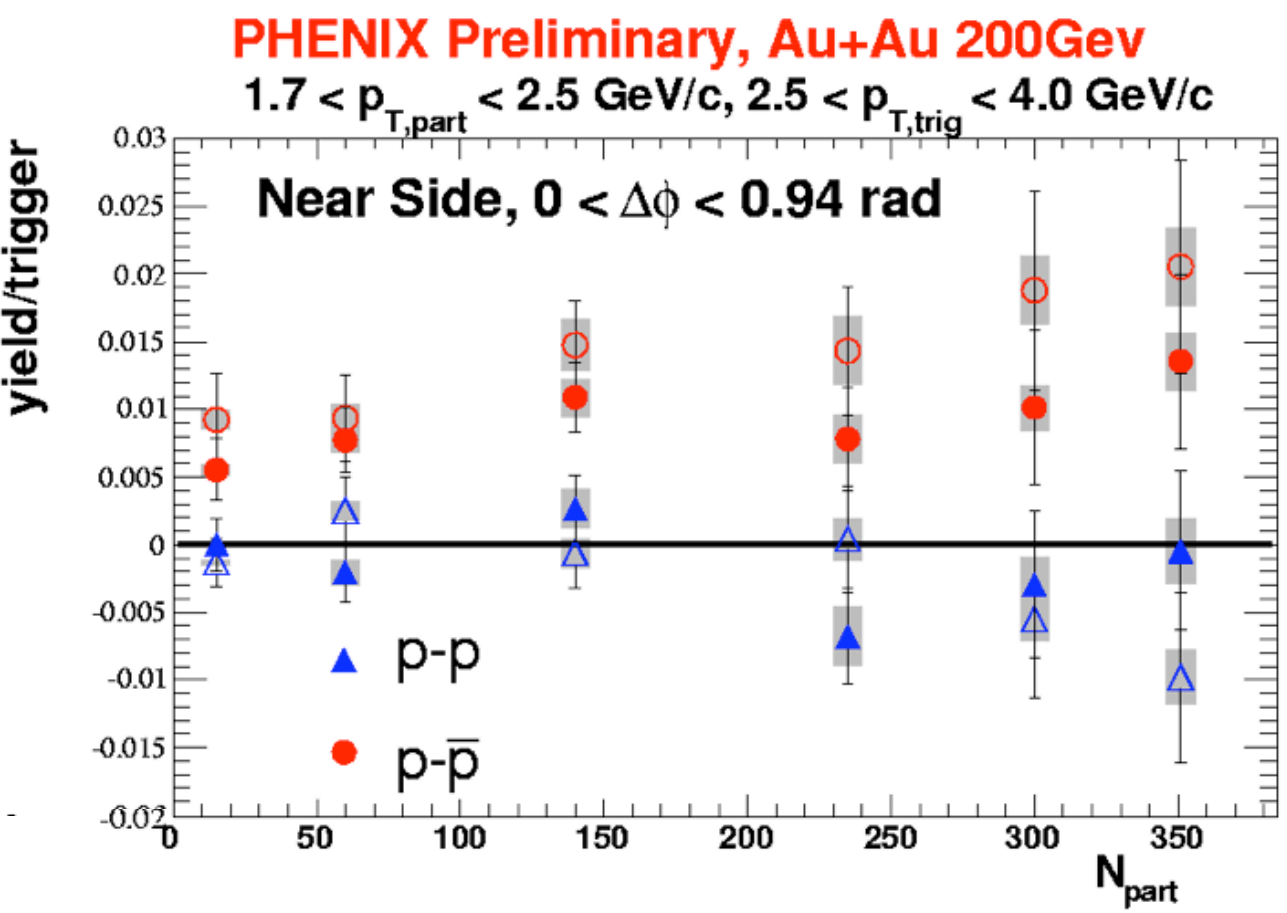
Partner Ratios--Same Side

trigger: $2.5<p_T<4.0$ GeV/c
charged hadron trigger



with charged hadron triggers we do see an increase in associated baryon to meson ratio with centrality (and p_T)

p & $\bar{p}$ Correlations



ɡger: 2.5<pT<4.0 GeV/c
tner: 1.7<pT<2.5 GeV/c

Opposite Charge

p-$\bar{p}$ & $\bar{p}$-p

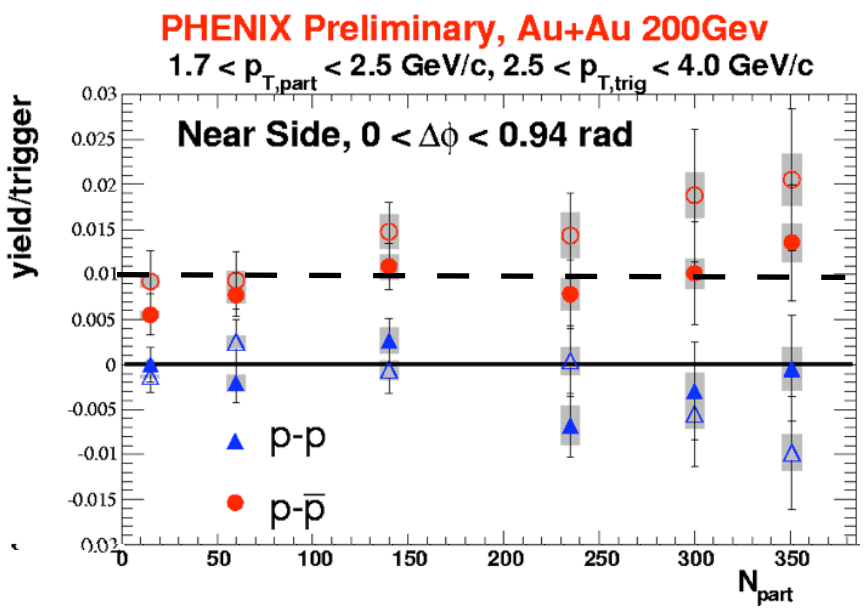
Same Charge

p-p & $\bar{p}$-$\bar{p}$

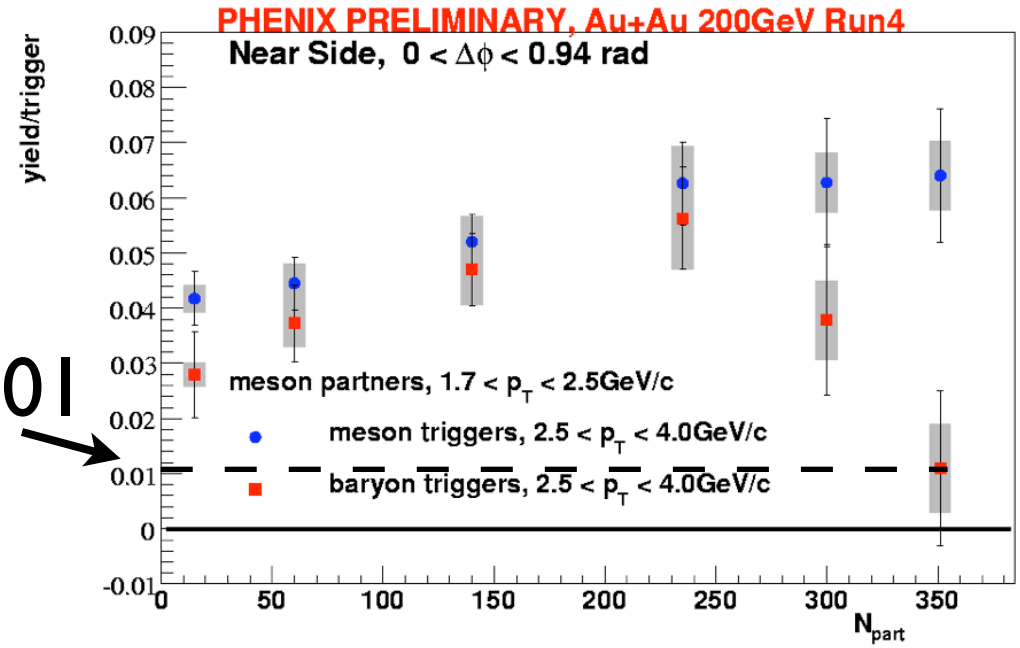
ɔnsistent with baryon number conservation in near side jet correlation

No significant centrality dependence

different fragmentation for baryon triggered jets?



0.01



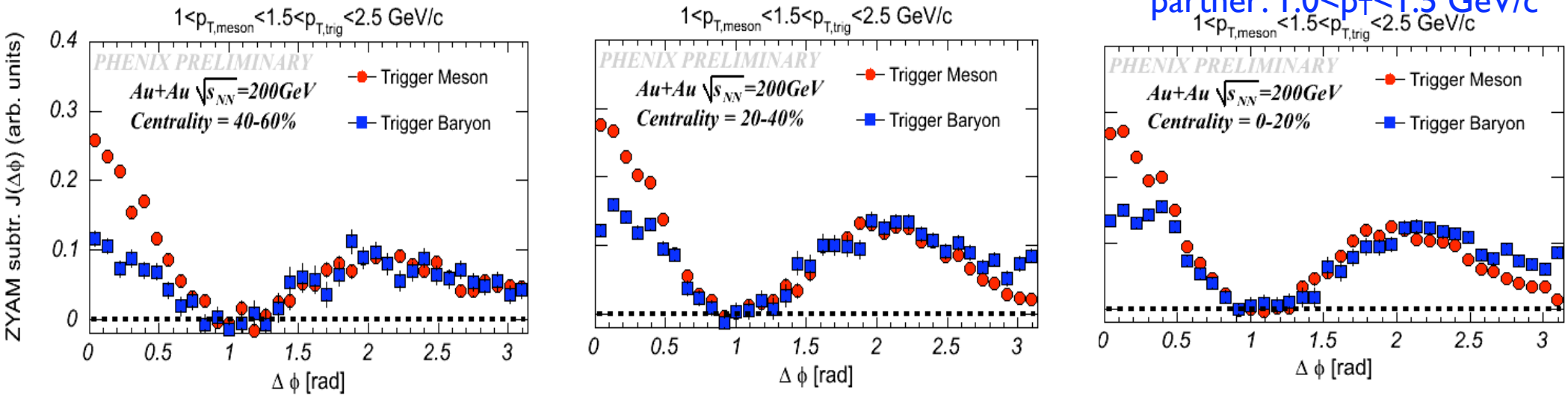
in very central collisions proton have comparable probability to fragment into anti-protons and mesons

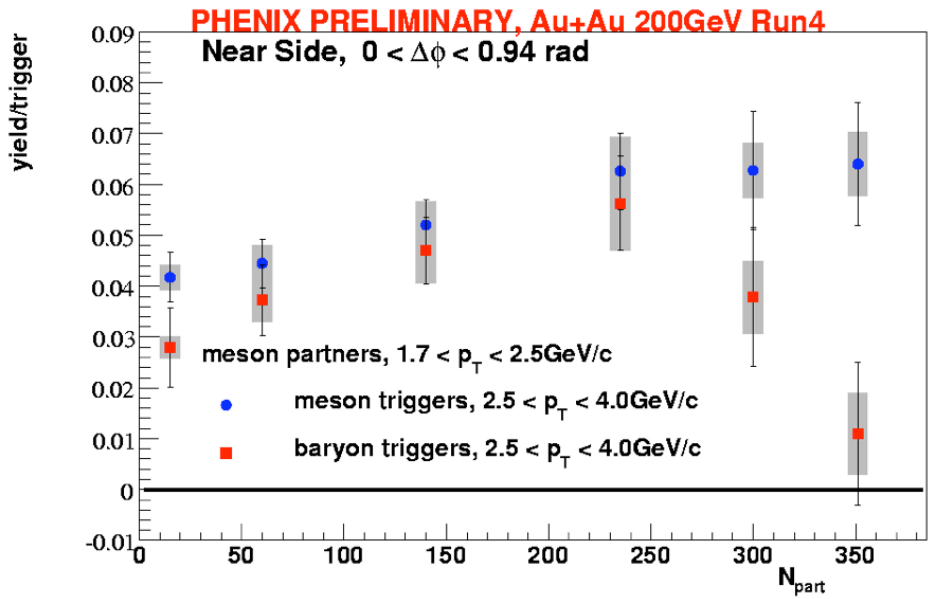
is this where the increased assoc. baryon/meson ratio comes from?

trigger: 2.5<pT<4.0 GeV/c
partner: 1.7<pT<2.5 GeV/c

Lower p_T: Meson Partners

trigger: $1.5<p_T<2.5$ GeV/c
partner: $1.0<p_T<1.5$ GeV/c





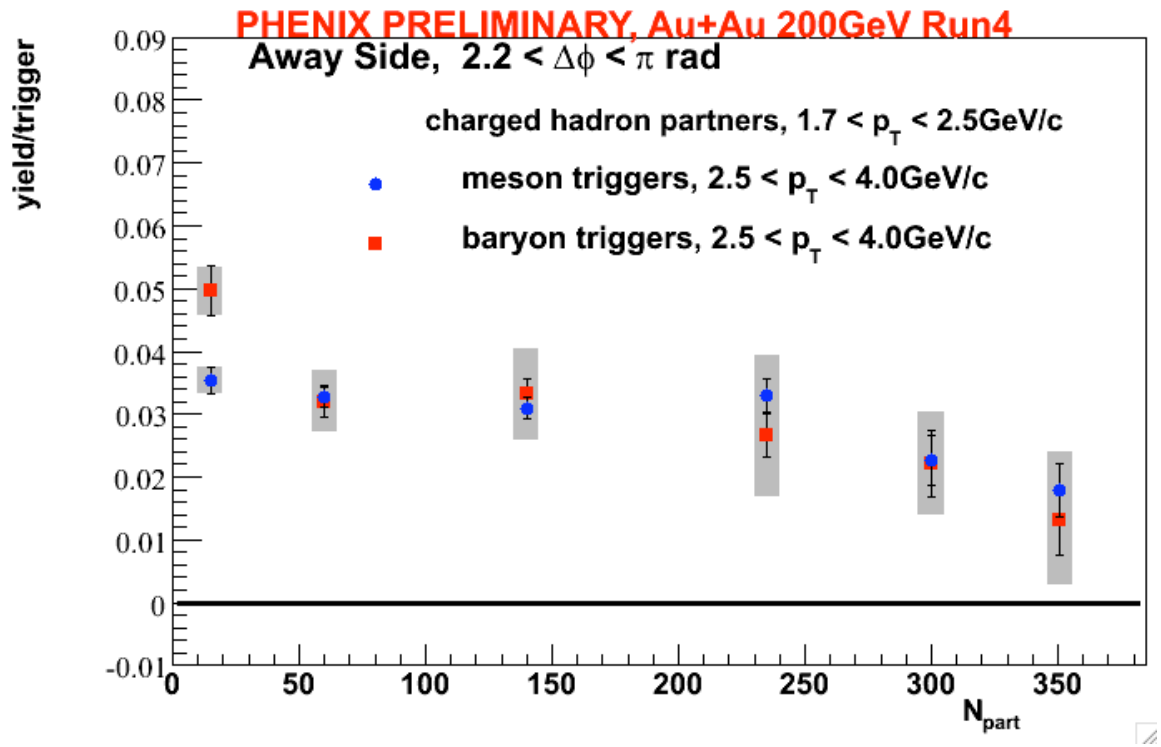
trigger: $2.5<p_T<4.0$ GeV/c
partner: $1.7<p_T<2.5$ GeV/c

Very different centrality dependence!

Away Side Correlations

Away Side Yields

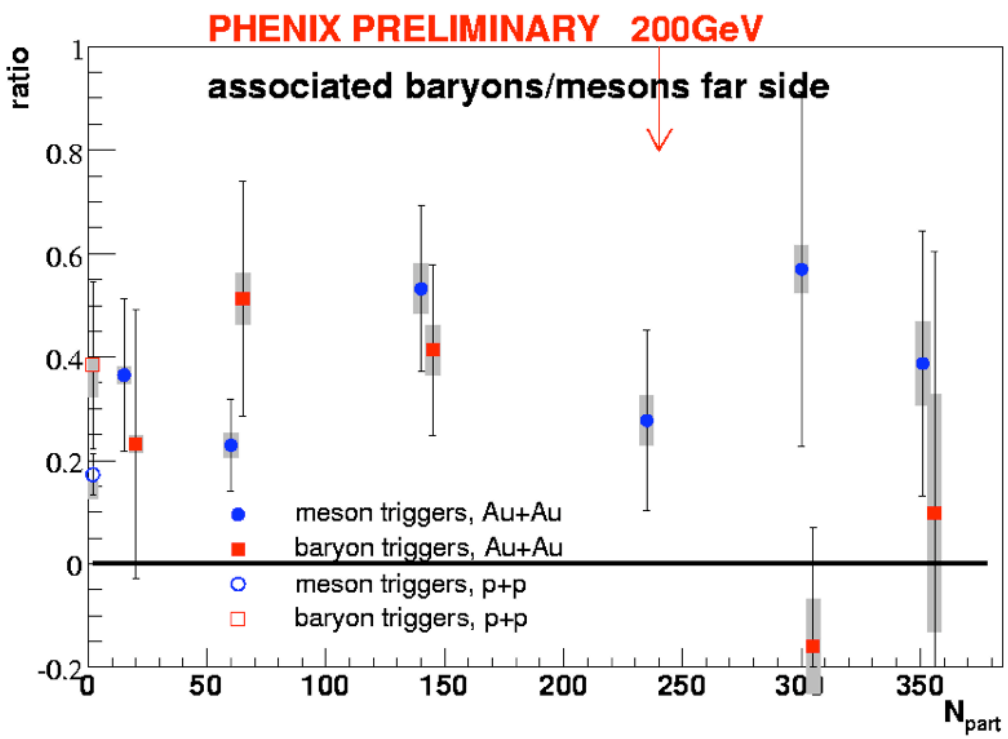
trigger: 2.5<pT<4.0 GeV/c
partner: 1.7<pT<2.5 GeV/c
charged hadron partners



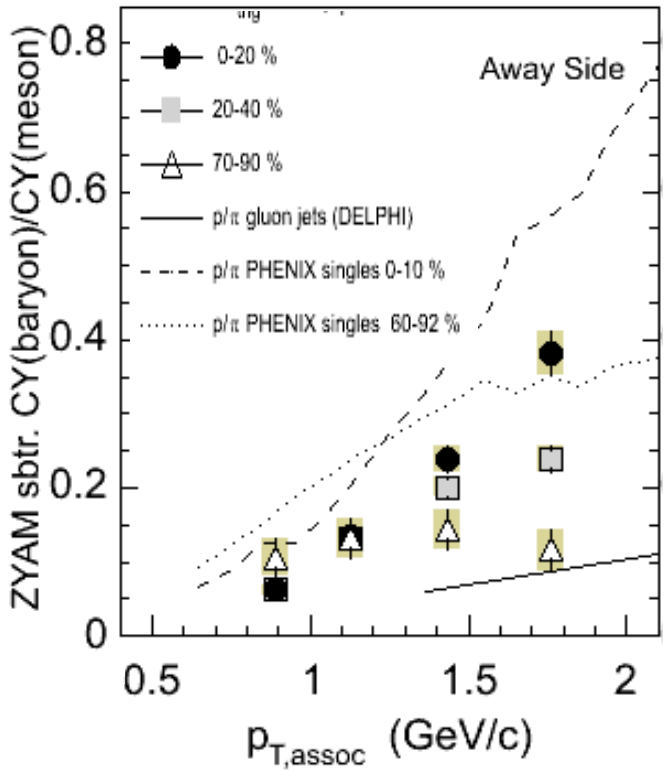
No significant difference between baryon & meson triggers

Partner Ratios--Away Side

trigger: $2.5<p_T<4.0$ GeV/c
partner: $1.7<p_T<2.5$ GeV/c
trigger identified



trigger: $2.5<p_T<4.0$ GeV/c
trigger not identified



central

peripheral

baryon to meson ratio of away side jet particles increases with p_T, but is still much lower than for single particles

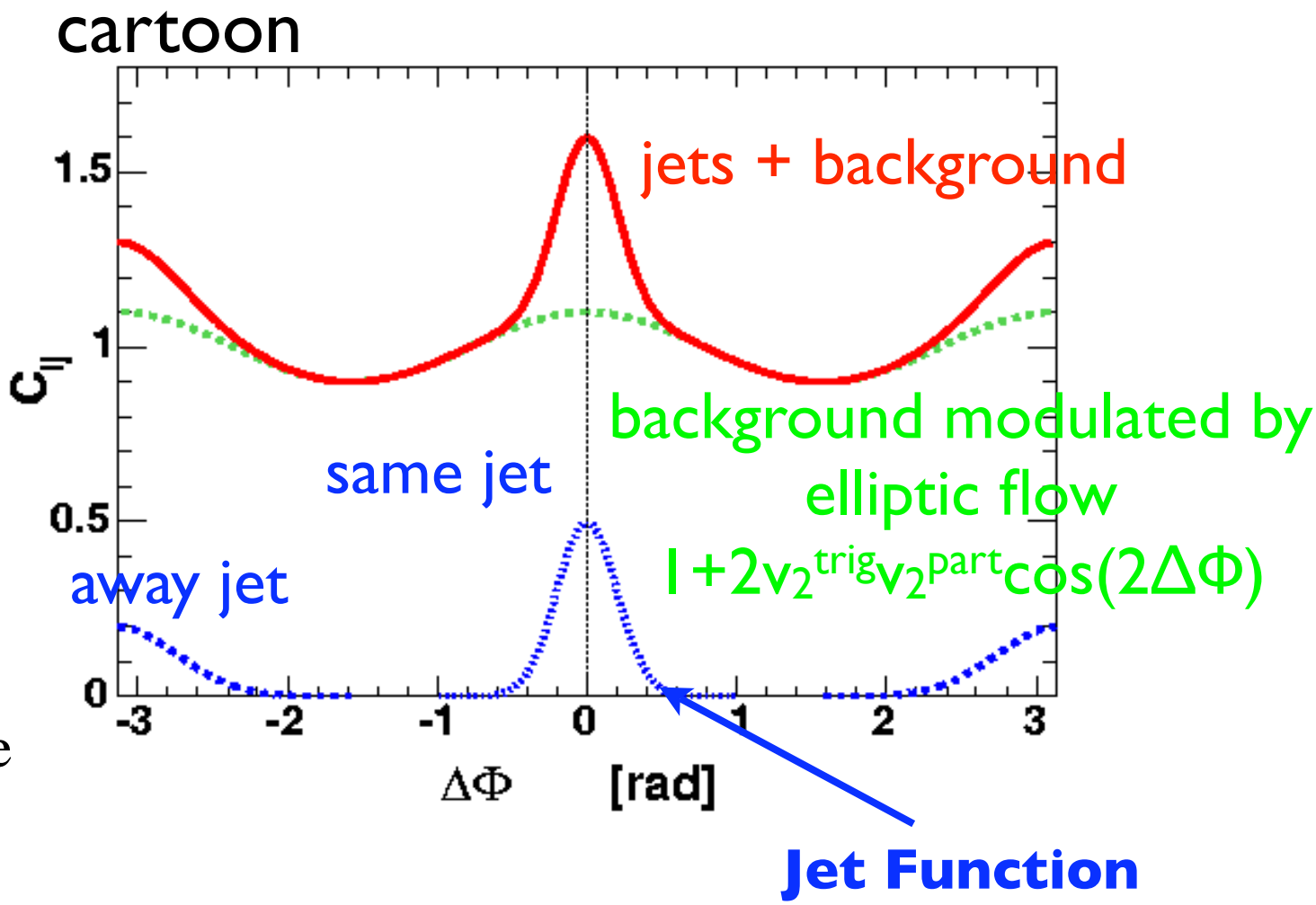
Conclusions

- near side correlations show fragmentation is modified in a species dependent manner
  - baryon excess is from hard scattering
  - in most central collisions protons are about as likely to have associated anti-protons (the opposite) as mesons
  - what role does recombination play?
- away side yields show no trigger dependence
  - makes sense if baryon & meson triggers come from about the same parton energy & fragment independently
- away side associated particles are more baryon rich in central AuAu collisions

BACKUP

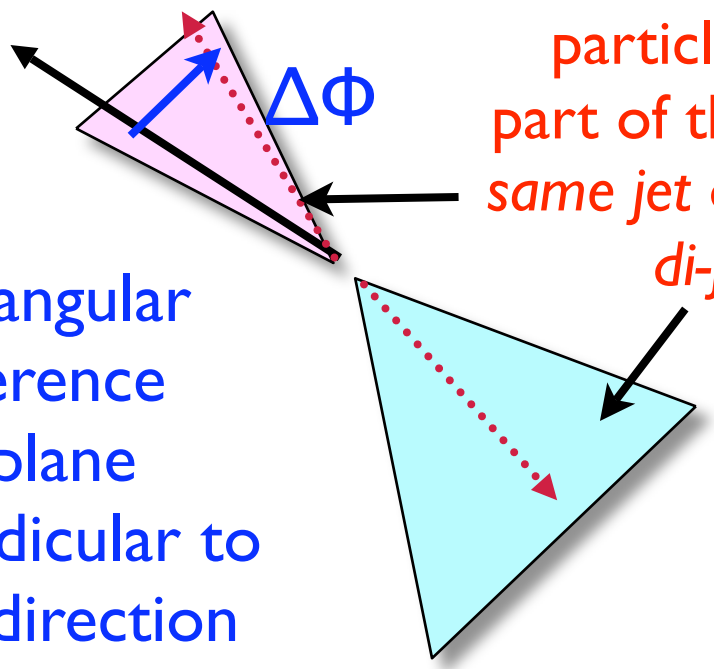
Finding the Jet Signal

- large combinatoric background in heavy ion events
  - due to the underlying event multiplicity
  - either calculate the rate or assume there is a region in $\Delta\phi$ where the signal doesn't contribute (ZYAM)



Two Particle Correlations

Trigger: rare "high" p_T particles
identify a hard scattering



Partners: lower p_T particles part of the *same jet* or *di-jet*

ΔΦ: angular difference in plane perpendicular to beam direction

- identify jets statistically
  - triggers provide biased jets
- model independent
- works well in all collision systems at RHIC
- correct for non-uniform PHENIX azimuthal acceptance divide real Δϕ distributions by those from mixed events (contain no correlations)